Gregory G. Leptoukh 2012 Online Giovanni Workshop Abstracts

Next Generation of Giovanni

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The current generation of Giovanni ("G3") has provided analysis and visualization services for remote sensing and related data for several years now. However, with growing needs of the community to analyze and compare more and more data, the G3 architecture has begun to show signs of strain. The GES DISC is in the process of developing the next generation of Giovanni ("G4") to satisfy these needs and to be more evolvable over the long term. G4 will have improved performance for many of the plots, in some cases by more than an order of magnitude. It will also have an "omnibus" portal, which will enable comparison of many more datasets to each other. It will also include new services, such as in interactive scatterplot/map combination.

G4 will be released for beta testing with a subset of the G3 services and datasets. However, G3 will remain available as data and services are migrated to G4, and for some overlap period after migration is finished.

Use of MODIS data for Inferring Radiative Fluxes and their Application

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Abstract

MODIS observations and information as produced by various working groups are well suited for deriving radiative fluxes in the atmosphere. One unique aspect of these products is related to the fact that the needed information for driving radiative flux inference schemes comes from the same instrument and as such, is co-located in space and time. We have developed capabilities to derive shortwave and longwave radiative fluxes at various levels of the atmosphere using the MODIS based information. We will briefly review what was done and focus on applying this newly derived information to climate issues that require such information at the surface.

Use of GIOVANNI system in Public Health Application

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Abstract

The role of environment and climate in propagating infectious disease has long been recognized since the 5th century. The effect is particularly evident in vector-borne diseases such as malaria where temperature, precipitation and humidity influence the lifecycle of the pathogens and mosquitoes. Likewise, the transmission of respiratory diseases is also often associated with climatic factors. For example, a recent study showed that low humidity and temperature provides efficient condition for seasonal influenza transmission. Understanding of how environment and climate affect infectious diseases would essentially provide guides to prevent and control the spread of disease. Toward this end, our group has developed models for infectious disease risk – such as for malaria, dengue and influenza – that are driven by climatic and environmental inputs. Results will be presented, especially those that used TRMM data from GIOVANNI.

Satellite Remote Sensing for Malaria Epidemic Early Warning in a Highland Region of Ethiopia

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Abstract

Epidemic malaria is a major public health problem in the highlands of East Africa. Identifying the climatic triggers that increase malaria risk affords a basis for developing environmentally-driven early warning systems. Satellite remote sensing provides a wide range of environmental metrics that are sensitive to temperature, rainfall, and other climatic variables. The goals of this study were to test the utility of remotely-sensed environmental monitoring data for modeling and forecasting malaria epidemics in the Amhara region of Ethiopia. We examined two different modeling approaches. Seasonal autoregressive integrated moving average (SARIMA) models were used to model monthly time series of malaria cases summarized at the *woreda* (district) level using TRMM rainfall, MODIS land-surface temperature (LST), vegetation indices (NDVI and EVI) computed using MODIS nadir BRDF-adjusted reflectance, MODIS actual evapotranspiration (ETa). Malaria cases exhibited positive associations with LST at a lag of one month and positive associations with indicators of moisture (rainfall, EVI and ETa) at lags from one to three months. SARIMA models that included these environmental covariates had better fits and more accurate predictions, as evidenced by lower AIC and RMSE values, than models without environmental covariates. We also implemented a seasonal modeling approach that examined associations between relative malaria risk at the district level during the main epidemic season (September-December) and remotely-sensed LST, NDVI, precipitation, and ETa anomalies measured earlier in the year. Malaria epidemics during were associated with higher-than normal rainfall in February-March, warmer-than-normal temperatures in May-June, and higher-than normal rainfall in August-September. Giovanni was used to acquire the historical TRMM data for data analysis and model parameterization. We have also developed a computer application (EASTWeb) to automatically acquire and process these remote sensing datasets for malaria early warning applications. Continued environmental monitoring using satellite remote sensing will allow us to forecast the environmental risk of malaria epidemics in future years and validate these initial results.

Hydrology Research with the North American Land Data Assimilation System (NLDAS) Datasets at the NASA GES DISC using Giovanni

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Abstract

The North American Land Data Assimilation System (NLDAS) is a collaboration project between NASA/GSFC, NOAA, Princeton Univ., and the Univ. of Washington. NLDAS has created a surface meteorology dataset using the best-available observations and reanalyses; the backbone of this dataset is a gridded precipitation analysis from rain gauges. This dataset is used to drive four separate land-surface models (LSMs) to produce datasets of soil moisture, snow, runoff, and surface fluxes. NLDAS datasets are available hourly and extend from Jan 1979 to near real-time with a typical 4-day lag. The datasets are available at 1/8th-degree over CONUS and portions of Canada and Mexico from 25-53 North. The datasets have been extensively evaluated against observations, and are also used as part of a drought monitor.

NLDAS datasets are available from the NASA GES DISC and can be accessed via ftp, GDS, Mirador, and Giovanni. GES DISC news articles were published showing figures from the heat wave of 2011, Hurricane Irene, Tropical Storm Lee, and the low-snow winter of 2011-2012. For this presentation, Giovanni-generated figures using NLDAS data from the derecho across the U.S. Midwest and Mid-Atlantic will be presented. Also, similar figures will be presented from the landfall of Hurricane Isaac and the before-and-after drought conditions of the path of the tropical moisture into the central states of the U.S. Updates on future products and datasets from the NLDAS project will also be introduced.

Monitoring Extreme Rain Events using Giovanni

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It is well-documented that extremely heavy rain events all around the world result in flooding and have enormous socio-economic and environmental consequences. Recent climate model projections suggest that in the warming climate, many parts of the world may experience increased number of extreme rain events. Analysis of regionally focused past heavy rain events, and associated atmospheric conditions would be very useful in understanding and documenting such events which can potentially be helpful in monitoring future extreme events. This presentation will include analysis of a number of flood-inducing rain events over the mid-western US, Colombia (South America), and Western India, conducted by using TRMM, Aqua/AIRS, Aqua/MODIS, and MERRA from NASA-Giovanni portals. Some of these case studies are developed as a part of NASA Applied Remote Sensing Training (ARSET) –Water Resource Management program (http://water.gsfc.nasa.gov) in which a variety of national and international endusers receive hands-on training on using Giovanni to access NASA water resource products for water resource management activities.

The Data-enhanced Investigations for Climate Change Education (DICCE) Project

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Abstract

Data-enhanced Investigations for Climate Change Education (DICCE), a NASA climate change education project, employs the NASA Giovanni data system to enable teachers to create climate-related classroom projects using selected satellite and assimilated model data. The easy-to-use DICCE Giovanni portal (DICCE-G) provides data parameters relevant to oceanic, terrestrial, and atmospheric processes. Particular effort has been devoted to the creation of ancillary material to enable teachers to enter into the data environment with relative ease and to understand the climate relevance of diverse data products. The companion DICCE Learning Environment (DICCE-LE) for classroom project development will also be demonstrated, along with several teacher- and student-created climate projects.

Utilizing GIOVANNI in Earth System Science Education Alliance Learning Modules

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Abstract

The Earth System Science Education Alliance (ESSEA) (http://esseacourses.strategies.org/) is a NASA, NSF and NOAA-supported program implemented by the Institute for Global Environmental Strategies (IGES) to improve the quality of geoscience instruction for pre-service and in-service K-12 teachers. ESSEA members, over 40 institutions from across the United States, have produced earth system science instructional modules that are freely available through the ESSEA website. The modules introduce the learner to the topic under study via a scenario. The scenario is followed with a tasking statement. Learners working on the module formulate a solution based on their understanding of the earth system that is developed through the assignments within the module. The module provides links to resources and activities that the learners utilize to develop their knowledge base in order to provide a response to the task. An important feature of the ESSEA modules is the use and interpretation of earth system data in formulating a scientifically grounded response to the task. During this presentation two modules, **Carbon City** (http://esseacourses.strategies.org/module.php?module_id=174) and **When the Extremes Become the Means** (http://esseacourses.strategies.org/module.php?module_id=181) will be viewed and illustrate how GIOVANNI is utilized to address the data analysis essential to the completion of the modules.

Exploring Land Processes and Climate Variations through Giovanni

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A number of remotely sensed land products from sensors, such as MODIS, AMSR-E, and DMSP-OLS, etc. are available in the Giovanni system. Data resolution varies from 1 degree to 500m for large or small scale studies. This presentation will give a quick overview of satellite remotely sensed land products in Giovanni . Sample plots generated from Giovanni illustrate land processes and climate variations: as examples, NDVI anomaly due to local seasonal anomalous temperature or water supply; local climate change, indicated by land surface temperature, due to land use change associated with urbanization; and seasonal and interannaul variations of active fire. The detailed product list can be found at: *http://disc.sci.gsfc.nasa.gov/mairs/data-holdings*

NEAR REAL-TIME DISTURBANCE MONITORING USING IMAGE TIME SERIES

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ABSTRACT

Monitoring disturbances is critical for addressing its impact on ecosystems dynamics such as for example, carbon storage and fluxes at a global scale and productivity of agriculture fields at a local scale. In-situ sensors and satellite remote sensing enables cost-effective and accurate monitoring at frequent time steps over large areas. Several methods are available to detect disturbances within time series data. However, methods to detect changes in near real-time need to be further improved. There is a critical need for methods that enable rapid and automated analysis of in-situ sensors and satellite image time series to detect disturbances in near real-time.

Here, we demonstrate an approach to detect disturbances in near real-time. The method detects disturbances in near realtime by comparing newly acquired data with a modelled stable period based on historic in-situ or satellite time series data. The method allows the automated differentiation between normal and abnormal change in near real-time and is based on the *Break For Additive Seasonal Trend* (**BFAST**) concept [1, 2, 3]. Demonstration is done by analysis of 16-day MODIS satellite image time series (MOD13Q1) for Eastern Africa. Results illustrate that abrupt changes are successfully detected while being robust for high noise levels. The method is publicly available within as the *bfastmonitor* function within the BFAST package for R (http://bfast.r-forge.r-project.org/). The proposed method is an automated and robust change detection approach that can be applied on different types of data (e.g. *in-situ* sensor data, or earth observation data time series) since it is fast and does not require time series gap filling. The method can be integrated within current operational early warning systems and has the potential to detect a wide variety of disturbances (e.g. deforestation, flood damage, pests and diseases).

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[3] Jan Verbesselt, Achim Zeileis, and Martin Herold, “Near real-time disturbance detection in terrestrial ecosystems using satellite image time series: Drought detection in somalia (in review),” Remote Sensing of Environment, 2012.

MAPSS and AeroStat: integrated analysis of aerosol measurements using Level 2 Data and Point Data in Giovanni

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ABSTRACT

During the past couple of decades, there have been increased efforts to employ satellite remote sensing in measuring aerosols. As one of the premier NASA Earth System analysis tools, Giovanni system provides a convenient access to the vast amounts of the gridded Level-3 aerosol data collected by aerosol-measuring satellite sensors on a daily basis. Since atmospheric aerosols impact air quality, the hydrological cycle, and climate, Giovanni has become a truly indispensable tool to both scientists and decision makers. However, to advance the current state of knowledge about the global impact of aerosols and to enable analysis of associated uncertainties, it has become necessary to extend Giovanni to support aerosol products at higher resolutions, particularly at the level of retrieval (Level 2), and also to support aerosol point data from available ground-based observation networks such as the Aerosol Robotic Network (AERONET).

These goals were tackled by implementing Giovanni support for Multi-sensor Aerosol Products Sampling System (MAPSS). MAPSS was designed to facilitate integrated analysis of Level-2 aerosol measurements acquired with different types of instrumentation, such as Terra-MODIS, Aqua-MODIS, Terra-MISR, Aura-OMI, Parasol-POLDER, Calipso-CALIOP, and SeaStar-SeaWiFS satellite sensors. MAPSS consistently samples aerosol products from these spaceborne sensors using a unified spatial and temporal resolution, where each dataset is sampled over important ground-based locations together with coincident AERONET data samples. In this way, MAPSS enables a direct cross-characterization and data integration between aerosol products from multiple sensors. Moreover, the well-characterized co-located ground-based AERONET data provides the basis for the integrated validation of these products.

In our presentation, we will explain principles of the sampling approach used by MAPSS and demonstrate how MAPSS is integrated with Giovanni. We will also demonstrate integrated analysis of multiple aerosol products over selected locations. Finally, we present AeroStat, a sister system of MAPSS that supports statistical analysis of the MAPSS data and provides facilities for direct analysis and visualization of the Level-2 data.

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Emission and Transport of Cesium-137 from Boreal Biomass Burning

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Abstract

Although atmospheric concentrations of Cesium-137 (^{137}Cs) decreased after the nuclear testing era, resuspension of ^{137}Cs during biomass burning provides an ongoing emission source. The summer of 2010 was an intense biomass-burning season in western Russia, with high levels of particulate matter impacting air quality and visibility. Since ^{137}Cs binds to aerosols, satellite observations of aerosols and fire occurrences can provide a global-scale context for ^{137}Cs emissions and transport during biomass-burning events. We compare MODIS aerosol optical depth data, obtained from Giovanni, to ^{137}Cs data from radionuclide monitoring stations in western Russia and Canada. We find that high values of MODIS aerosol optical depth coincide with increased detections of ^{137}Cs during the wildfire period. Based on the relationship between ^{137}Cs and aerosols, we model the transport of ^{137}Cs from biomass burning using the emissions and transport of organic carbon in the GEOS5 model. The model's boreal biomass-burning tracer explains approximately half of the daily variability in detected ^{137}Cs concentrations at a monitoring station in western Russia. Constraining the model with the station observations, we calculate ^{137}Cs emissions of 1.5×10^{12} Bq from biomass burning north of 40° in July and Aug. 2010. These emissions and the subsequent deposition lead to a small northward redistribution of ^{137}Cs.

Exploring the Longwave Radiative Effects of Dust Aerosols

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Dust aerosols not only affect air quality and visibility where they pose a significant health and safety risk, but they can also play a role in modulating the energy balance of the Earth-atmosphere system by directly interacting with local radiative fields. Consequently, dust aerosols can impact regional climate patterns such as changes in precipitation and the evolution of the hydrological cycle. Assessing the direct effect of dust aerosols at the solar wavelengths is fairly straightforward due in part to the relatively large signal-to-noise ratio in broadband irradiance measurements. The longwave (LW) impacts, on the other hand, are rather difficult to ascertain since the measured dust signal level (~10 Wm^{-2}) is on the same order as the instrumental uncertainties. Moreover, compared to the shortwave (SW), limited experimental data on the LW optical properties of dust makes it a difficult challenge for constraining the LW impacts. Owing to the strong absorption features found in many terrestrial minerals (e.g., silicates and clays), the LW effects, although much smaller in magnitude compared to the SW, can still have a sizeable impact on the energetics of the Earth-atmosphere system, which can potentially trigger changes in the heat and moisture surface budgets, and dynamics of the atmosphere. The current endeavor is an integral part of an on-going research study to perform detailed assessments of dust direct aerosol radiative effects (DARE) using comprehensive global datasets from NASA Goddard's mobile ground-based facility (*cf*. http://smartlabs.gsfc.nasa.gov/) during previous field experiments near key dust source regions. Here we examine and compare the results from two of these studies: the 2006 NASA African Monsoon Multidisciplinary Activities and the 2008 Asian Monsoon Years. The former study focused on transported Saharan dust at Sal Island (16.73°N, 22.93°W), Cape Verde along the west coast of Africa while the latter focused on Asian dust at Zhangye China (39.082°N, 100.276°E), a semi-arid region between the Taklimakan and Gobi deserts. NASA Goddard's Giovanni system is used to help map out the spatial distribution of retrieved aerosol optical depths across the latter desert regions. 1-D radiative transfer model constrained by local measurements, including spectral photometry/interferometry and lidar for characterizing the spatiotemporal variability in dust properties and atmospheric conditions, is employed to evaluate the local instantaneous LW DARE of dust both at the surface and at the top of the atmosphere along with heating rate profiles for cloud-free atmospheres. The efficiency in LW DARE and its significance relative to the diurnally averaged SW effects are explored and compared in both studies. Found to be non-negligible, LW DARE is an important component in the study of regional climate variation with important implications for more detailed global assessments.

Chlorophyll variability along the Louisiana-Texas coast from satellite wind and ocean color data

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Abstract

SeaWiFS-derived chlorophyll *a* (chlorophyll) were used in conjunction with QuikSCAT satellite based vector wind data to examine wind influence on short- and long-term surface chlorophyll distribution in the northern Gulf of Mexico waters influenced by the Mississippi and Atchafalaya Rivers, the largest in North America. During a cold front passage in March 2002, satellite derived wind field revealed a systematic shift in direction and amplitude of the winds that strongly influenced the surface chlorophyll distribution. Both the offshore extent and westward transport of enhanced surface chlorophyll biomass increased following the frontal passage. Surface wind stress derived from the 12.5 km high resolution QuikSCAT winds mapped along with SeaWiFS derived surface chlorophyll obtained from Giovanni and monthly high resolution imagery during a low flow and a normal river discharge year in 2000 and 2001 indicated the dominant role of river discharge in influencing the concentration and extent of chlorophyll in the plume and inner shelf waters. However the magnitude and direction of wind stress influenced the plume orientation, the cross-shelf extent of a coastal band of elevated chlorophyll, and its offshore variability.

Ten Years of Springtime MODIS-Aqua Euphotic Depth Anomalies in Lake Michigan

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Abstract

The initiation of nearly-continuous remote-sensing observations of the United States' Great Lakes revealed the semi-regular occurrence of a resuspended sediment turbidity feature in southern Lake Michigan. This feature was more commonly observed in spring when northerly winds dominate, causing increased wave action in the southern end of the lake and a wind-induced coastal current regime. The sediment resuspension feature was studied during the Episodic Events in the Great Lakes Experiment (EEGLE) in the 1998-2000 time period.

The new availability of 4 km resolution euphotic depth anomalies in Giovanni allows examination of this phenomenon for a 10-year period of MODIS-Aqua mission observations. The euphotic depth data show the occurrence of the turbidity feature early in the period, but its recurrence becomes less regular in the later years of the study period. A time-series of euphotic depth anomalies for the southeastern end of the lake indicates the reduction in euphotic depth anomalies over the period. This preliminary survey is not intended to indicate causation of the apparent observed changes in this phenomenon, but given other known changing factors in the Great Lakes climate, investigating the linkage to these factors would indicate potential connectivity.

One particularly anomalous event was observed in June 2008, during which euphotic depth along the western (Wisconsin) coast of the lake was markedly increased, and also to a lesser extent along the eastern (Michigan) coast. This anomaly appears to be due to river runoff related to heavy Midwestern rainfall during June 2008.
(http://adsabs.harvard.edu/abs/2008AGUFMOS11D1158C)

Fisher success and adaptation to plantation systems in Chile

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Abstract

This study examined fisher success in southern Chile's *loco* (*Concholepas concholepas*) and *congrio* (*Genypterus chilensis*) fishery. The *loco* fisheries are in exclusive access territories that vary in relationship to tree-plantation development, which can affect shellfish quality. The *congrio* fishery is open access and located further offshore. The relative importance of a fishers' experience and capture technology were evaluated against environmental and geospatial characteristics. These data were gathered via structured interviews, ecological surveys, and remote sensing using NASA's Giovanni program.

Environmental conditions (# of shell boring organisms and phytoplankton biomass) were the main predictor of fisher success (price reportedly paid/kg loco and monthly profit) in the loco fishery. Technology and experience were the main predictors of success for the offshore congrio fishery.

Those fishers with sufficient experience that were not successful with the *loco* fishery moved to offshore fisheries. Offshore the environmental condition played a smaller role in determining success. As planation systems become more dominant across the globe to mitigate climate change and to support a growing population, the shifts in fisher livelihoods need to be evaluated. NASA's Giovanni tool offers a system to systematically analyze changes in the nearshore systems as a result from plantations. This tool, combined with analyzes of fishing activities and interviews can help to understand how fisheries respond to the influx of nutrients into the nearshore system and what strategies are most successful in responding to change.

Assessing the effects of climate variability on phytoplankton composition in the Pacific Ocean using a biogeochemical model

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Abstract

The NASA Ocean Biogeochemical Model (NOBM) is a biogeochemical model of the global oceans that is coupled with a circulation and radiative model (Gregg and Casey, 2007). The Giovanni website provides a platform to download the data from this model including 4 explicit phytoplankton groups, mixed layer depth and nutrients. Total chlorophyll fields in NOBM are assimilated using Sea-viewing Wide Field-of-view Sensor (SeaWiFS) data from 1998-2010 using a multi-variate assimilation approach (Rousseaux and Gregg, 2012). The model has been extensively validated (Gregg and Casey, 2007; Gregg et al., 2003) against in situ and/or satellite data sets. The NOBM data available through Giovanni have been used in diverse applications of biological and physical oceanography worldwide (e.g. Bracher et al., 2009; Rahul et al., 2010; Sadeghi et al., 2011; Wang et al., 2010). Here we present a study (Rousseaux and Gregg, 2012) on the effect of climate variability on the phytoplankton community in the tropical and sub-tropical Pacific Ocean between 1998 and 2007 using NOBM data available on Giovanni. The phytoplankton communities exhibited a wide range of responses to climate variability, from radical shifts in the Equatorial Pacific, to changes of only a couple of phytoplankton groups in the North Central Pacific, to no significant changes in the South Pacific. In the Equatorial Pacific, climate variability represented by ENSO dominated the variability of phytoplankton. Here, nitrate, chlorophyll and all of the 4 phytoplankton types (diatoms, cyanobacteria, chlorophytes and coccolithophores) were strongly correlated ($p<0.05$) with the Multivariate El Niño Southern Oscillation Index (MEI). During La Niña events, diatoms increased and expanded westward along the cold tongue (correlation with MEI, $r= -0.87$, $p<0.05$), while cyanobacteria concentrations decreased significantly ($r= 0.69$, $p<0.05$). El Niño produced the reverse pattern, with cyanobacteria populations increasing while diatoms plummeted. In the North Central Pacific, the MEI was significantly correlated with diatoms ($r= -0.40$) and chlorophytes ($r= -0.43$). Ocean biology in the South Pacific was not significantly correlated with MEI. These results highlight the spatially variable nature of the relationship between phytoplankton community structure and climate variability within the Pacific Ocean.

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Understanding Atmospheric Chemistry over China using in situ and Satellite observations

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Abstract

The rapid rising anthropogenic emissions over China have been documented by satellite observations and bottom-up inventories. These emissions have resulted in severely degraded domestic air quality and also have marked contribution to air pollution downwind. Multi-scale modeling analyses of in situ and satellite observations have been performed to understand atmospheric chemistry over polluted regions over China. Remarkable abundance of photochemical oxidants, especially up to 14 ppbv of PAN and ~1ppbv of HONO during daytime were observed during the CAREBeijing-2007 experiments in Beijing. Analyses using a 1-D photochemical model constrained by the observations suggest that reactive aromatic VOCs are the major source (~75%) of peroxy acetyl nitrate (PAN). Photo-enhanced aerosol surface uptake of NO_2 appears to be the predominant source of nitrous acid (HONO) during daytime (~70%). Besides, 3-D regional modeling analyses of tropospheric vertical column densities of glyoxal (CHOCHO) from SCIAMACHY show that anthropogenic emissions of aromatic VOCs are substantially underestimated (by a factor of 5 - 6, regionally varied) over China. Such an underestimation is suggested to be the main cause of a large missing source of CHOCHO over the region in current global models, and could also partly explain the underestimation of organic aerosols in previous modeling studies. Broader implications of these findings and the usefulness of satellite data and GIOVANNI will be discussed.

Atmospheric Research over Indian sub-continent using GIOVANNI data

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Abstract

South Asia in general, and Indian sub-continent, in particular, have attracted the global scientific interest during the last decades due to increasing levels of air pollution and anthropogenic aerosol emissions as a direct consequence of the rapid population growth, industrialization and urbanization. The increased levels of aerosols and air pollutants are responsible for the formation of brownish clouds over India, also extending over northern Indian Ocean, for the re-distribution of precipitation, for heating the lower and middle troposphere thus changing its stability, for influencing the onset, duration and intensity of the monsoon through aerosol-cloud-precipitation interactions and for melting the Himalayan glaciers. For assessing all these atmospheric and climate issues several ground-based atmospheric stations provide systematic aerosol measurements over India through the ARFI (Aerosol Radiative Forcing over India) project. However, recently, the use of satellite data over the region has been increasingly available. During the last 5 years numerous studies have used GIOVANNI tool for downloading atmospheric, hydrologic, radiation and cloud datasets over Indian sub-continent and adjoining oceanic regions either via satellite observations or re-analysis.

Focusing more on the recent 2 years, net downward solar radiation (NDSR) data, along with cloud optical depth retrievals at three atmospheric levels, have been used from MERRA-2D (Modern Era Retrospective-Analysis for Research and Applications) re-analysis over Hyderabad (Badarinath et al., 2010) and whole India (Kambezidis et al., 2012) analyzing the variability and trends in NDSR reaching the ground from 1979 to mid 2000s (solar dimming and brightening phenomenon). Both studies show a considerable decrease in NDSR (dimming), which was more associated to increasing trends in high level (> 400 hPa) clouds, but also to increasing aerosol emissions. Kaskaoutis et al. (2011) used MODIS Level 3 data from GIOVANNI to analyze the AOD trends over south Asia (including Indian sub-continent and adjoining oceanic areas) during the last decade 2000-2009, founding an overall increasing aerosol trend, but also a decline one over northern India and Ganges valley during May-August period. This trend was also verified from Kanpur AERONET data (Kaskaoutis et al. 2012a) and for this reason the same authors (Kaskaoutis et al., 2012b) focused on investigating the variability of dust activity over Thar desert, using GIOVANNI retrievals of rainfall TRMM anomalies, MODIS dark target and deep blue and TOMS. The results showed that the dust activity over Thar desert and the accumulation of dust aerosols over northern India were maxima during monsoon of 2002 and late pre-monsoon of 2003 due to deficit of precipitation. Thus, the GIOVANNI retrievals help in understanding that the neutral-to-negative trends of AOD over northern India during the last

decade in May-August period is attributed to extreme AOD values in 2002 and 2003 due to enhanced dust activity and atmospheric dust lifetime favored by the deficit of precipitation, prolonged dry and drought conditions. More recently, GIOVANNI was used for retrievals of latent heat, sensible heat and soil moisture via Noah-10 model (Kharol et al., unpublished data) for investigating the variability in land-atmospheric fluxes caused by significant land use – land cover (LULC) changes in Rajasthan state, India due to increased vegetation cover from irrigation via the Indira Gandhi canal.

GIOVANNI in the Arabian Sea

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Abstract

Sultan Qaboos University (SQU) is a public university in the Sultanate of Oman which has an extensive (over 2000 miles) coast line facing the Arabian Sea. SQU was opened in 1986 and named after the current Sultan of Oman, Qaboos bin Said. Currently, SQU has nine colleges with about 16 000 students (of which about 50% are females) and the annual budget of about 250 000 000 USD.

During the past five years, the NASA Giovanni data system has been extensively used by the Department of Marine Science and Fisheries (SQU) for education and scientific research. As far as the education is concerned, the faculty is using the Giovanni data system to teach graduate courses in the field of oceanography and marine ecology. The students learn how to construct time series and spatial distributions of the sea surface temperature, chlorophyll "a", and the other parameters characterizing physical-biological coupling in the upper layers of the ocean.

In terms of scientific approach, a group of faculty members has employed the Giovanni system to resemble the mesoscale and basin scale variability. In particular, the impact of mesoscale eddies on seasonal patterns of chlorophyll "a" concentration was studied. Satellite derived (SeaWIFS, TOPEX/Poseidon) products for chlorophyll-*a* concentration, sea surface heights, and calculated kinetic energy of eddies were employed, to analyze physical-biological coupling in the western Arabian Sea, from 1997 to 2008. It was shown that, when cyclonic eddies dominated throughout the year, the chlorophyll-*a* concentration was positively related to the kinetic energy of eddies. For the other years, when the total annual balance of negative to positive sea surface heights was dominated by anticyclonic eddies, the correlation was negative. The evaluated switch contributes a useful detail to the understanding of the mechanism mediating variability of the chlorophyll-*a* in regions with vigorous eddy fields.

On a basin scale, interannual changes of the chlorophyll *a* over entire Arabian Sea area subdivided into 61 2-degrees regions were analyzed. For each region, remotely sensed chlorophyll *a*, sea surface temperature, and wind speed time series were retrieved, from the GIOVANNI and the other data systems. The trend analysis based on the Mann-Kendall test has shown that the Arabian Sea is a well-balanced system exhibiting physical-biological oscillations with typical periods of 12 and 6 months (reflected the seasonality of monsoonal winds), with no rising trends of chlorophyll *a*, on the time scale of the past 12 years (1997-2009). This means that the sea did not get more productive.

Weekly Cycles in Tropospheric NO_2 Over Largest Urban Agglomerations Inferred From OMI Data

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Abstract

Nitrogen dioxide (NO_2) is a toxic gas whose accumulation in ambient air essentially reduces an air quality. Being one of the two most known nitrogen oxides it also plays a key role in tropospheric photochemistry. An essential portion of the air pollution in urban agglomerations is due to products of living activity. Differences in the intensity of anthropogenic emission between workdays and weekend may induce a weekly cycle (WC) in the tropospheric NO_2 content. Giovanni allows generating spatial distribution of NO_2 over a selected region in a separate day of week and also the time-series of NO_2 measurements spatially averaged over the same region. Using these capabilities of Giovanni and the retrievals of tropospheric NO2 columns obtained with the help of the OMI instrument we diagnosed WCs in tropospheric NO_2 content (hereafter NO_2) over 15 largest urban agglomerations during 2004-2009.

It is found that the amplitude of the local WC does not depend on corresponding local mean NO_2 content. Also there no clear correlation between the WC intensity and the geographical location of agglomeration. Maximum peak-to-peak amplitude of the WC is obtained in Los Angeles and reaches 64% of local mean NO_2 content. Despite the fact that the maximum of NO_2 content was found in Shanghai the WC over this agglomeration does not exceed 7%. WC of the same magnitude was diagnosed in populous Delhi. The most of WCs reveal themselves as weekend effects. Over all agglomerations except for two the weekly minimum of NO_2 content is observed on Sunday, while in Israel and Cairo the minimum reveals itself on Saturday and Friday respectively. We also investigated a credibility of existence of the weekly cycles in NO_2. For this purpose we tested statistical significance of intra-week differences in NO_2 with the help of the nonparametric Kruskal-Wallis test. The results of the test showed that in Shanghai and New Delhi these differences are not statistically significant. Over other considered agglomerations the intra-week differences in NO_2 are highly statistically significant.

The main focus of our work was analyzing the WC in NO_2 in Moscow which is the largest European agglomeration however it is insufficiently studied in this aspect. We describe the changes in spatial distribution of NO_2 over the Moscow region between the weekly maximum and minimum of NO_2. We also provide a comparison between the WC in NO_2 obtained on the basis of OMI data with the WC in surface NO_2 concentration obtained using in-situ NO_2 measurements in the Moscow's downtown. The comparison show a qualitative agreement between intra-week changes of columnar and local NO_2 contents however, rather unexpectedly, that the percentage amplitude of satellite signal is more than twice the amplitude in-situ signal.

Aerosol optical thickness trends and population growth in the Indian subcontinent

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Abstract

The anthropogenic aerosol concentrations have peaks in the densely-populated regions, many of which are concentrated in Asia. The current study was aimed at finding evidence that links urbanization to aerosol optical thickness and its trends over the Indian subcontinent, based on the eight-year NASA databases of Multiangle Imaging SpectroRadiometer (MISR) and Moderate Resolution Imaging Spectroradiometer (MODIS) satellite retrievals, from March 2000 to February 2008. MODIS and MISR data sets were acquired using the GES-DISC Interactive Online Visualization and Analysis Infrastructure (Giovanni) as part of NASA's Goddard Earth Sciences (GES) Data and Information Services Centre (DISC) from http://disc.sci.gsfc.nasa.gov [Acker and Leptoukh, Eos, 2007]. The subcontinent is characterized by high levels of air pollution due to intensively developing industries and mass fuel consumption for domestic purposes. Furthermore, it has a wide range of population density (persons/km^2), from zero in remote sites to thousands in the Ganges basin. The aforementioned factors give us the opportunity to quantify the effects of urbanization on aerosol optical thickness, averaged separately over regions with differing population densities. Currently available satellite measurements with global coverage provide us with evenly distributed aerosol optical thickness (AOT) data. This makes it possible to estimate aerosol effects on AOT trends over highly-populated areas. Our analysis has led us to the conclusion that, over the specified regions in the Indian subcontinent with differing population densities, (1) the higher the averaged population density – the bigger the averaged AOT, (2) the larger the population growth – the stronger the increasing trends in AOT. Over the regions with $P > 100$ persons/km^2 (more than 70% of the territory), a population growth of ~1.5% year^{-1} was accompanied by increasing AOT trends of over 2% year^{-1}. The presence of the aforementioned significant AOT trends is evidence of the current worsening of air quality. The population of the Indian subcontinent is already witnessing air quality deterioration and relating health problems due to anthropogenic aerosol emissions. This situation could become worse with the projected population growth in India.

Giovanni in Russia at Moscow state University: aerosol studies and educational process.

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Abstract

Giovanni is widely used in both educational and scientific process at the Faculty of Geography, Moscow State University.

1. Educational aspects:

For a couple of years I used Giovanni to get the students acquainted with different aerosol datasets including MODIS, MISR, OMI, etc. It is quite convenient to use friendly formats of data for having a quick look at the data and their variability. This activity is officially included in the course "Meteorological data set" at the Chair of Meteorology and Climatology, Faculty of Geography Moscow state University.

2. Scientific aspects:

A wide range of different kind of data and convenient infrastructure of data presentation provide a good tool for our scientific studies as well. Using MODIS data obtained via Giovanni a study of aerosol climatology over Europe has been fulfilled (Chubarova , 2009). The application of aerosol data from MODIS obtained again via Giovanni facility provide us useful information about AOT changes during extremely high smoke aerosol event over Moscow in August 2010 (Chubarova et al., 2012). Some of the results will be shown in presentation.

References:

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Propagation of Convective Complexes Monitored by Giovanni TRMM Imagery over the Southeastern Tropical N. Atlantic

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Abstract

Precipitation maxima during the West African summer monsoon propagate generally westward in tandem with African easterly waves. A heretofore unreported, repeating pattern of northward drift of precipitation maxima is detected on Tropical Rainfall Measurement Mission (TRMM satellite) time-latitude distributions of daily accumulations over the eastern tropical Atlantic, viewed via Giovanni. Corresponding 3-hourly TRMM accumulations show that the northward drifting envelopes of precipitation during August-September 2006 are often comprised of individual swaths propagating towards the southwest, presumably as mesoscale squall lines. The implied northward drift on the time-latitude distribution is a component of a resultant northwestward movement. The study examines the entire available record of TRMM precipitation observations, 1998-2010, to summarize TRMM maxima propagation over the eastern tropical Atlantic. Meridional displacements of precipitation maxima are most prevalent in June-September 2006, occurring less frequently during other summers. An investigation of geopotential and circulation fields, limited to two case studies, suggests mechanisms to explain some of the observed propagation of TRMM maxima. In one event, northward drift of the precipitation envelope is consistent with the corresponding displacement of the intertropical convergence zone trough, although the southwest propagation of individual mesoscale convection maxima does not correspond to any synoptic feature on reanalysis circulation or reanalysis downscaled by a regional model. One speculation is that southwestward propagation of precipitation maxima could be caused by regeneration of convection at outflow boundaries of mature thunderstorms.

Using Giovanni in Investigating the Links between Environmental Processes and Drought in Northern sub-Saharan Africa

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ABSTRACT

The northern sub-Saharan African (NSSA) region, bounded on the north and south by the Sahara and the Equator, respectively, and stretching East-West across Africa, is very vulnerable because of the highly active environmental and meteorological processes associated with its unique location and human activities that adversely impact the regional water cycle. Over the years, this region has suffered frequent severe droughts that have caused tremendous hardship and loss of life to millions of its inhabitants due to the rapid depletion of the regional water resources, as exemplified by the dramatic drying of Lake Chad. On the other hand, the NSSA region shows one of the highest biomass-burning rates per unit land area among all regions of the world. Because of the high concentration and frequency of fires in this region, with the associated abundance of heat release and gaseous and particulate smoke emissions, biomass-burning activity is believed to be one of the drivers of the regional carbon and energy cycles, with serious implications for the water cycle. An interdisciplinary research effort funded by NASA is presently being focused on the NSSA region, to better understand possible connections between the intense biomass burning observed from satellite year after year across the region and the water cycle, through associated changes in land-cover, surface albedo, emissions, atmospheric processes, precipitation, soil moisture, surface evaporation and runoff, and groundwater recharge.

A combination of remote sensing and modeling approaches is being utilized to investigate these multiple processes to clarify possible links between them. However, by using Giovanni, we are able to extract and jointly analyze some of the important relevant parameters to obtain a first insight into their relationships. In this presentation, we will discuss these preliminary results as well as the path toward improved understanding of the interrelationships and feedbacks between the water cycle components and the environmental change dynamics due to biomass burning and related processes in the NSSA region.

The Applied Remote Sensing Training (ARSET) Program

Richard D. Kleidman

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The Applied Remote SEnsing Training (ARSET) program is supported by NASA Applied Sciences and is tasked with providing professional training and education to those who wish to use remote sensing data for air quality and water resource applications. The ARSET Air Quality program is entering its fourth year and has provided both in person and web based training courses to over 300 participants.

Due to its accessibility and ease of use the ARSET program makes regular and heavy use of several Giovanni instances in its training. We use Giovanni not only to provide exposure to various remote sensing data products but also to teach principles of proper data usage and proper understanding of when and how to make best use of Giovanni. This presentation will show several examples of how we make use of Giovanni in our air quality training program.